WSDOT

SR 520 BRIDGE REPLACEMENT AND
HOV PROGRAM

SR 520 Floating Bridge and Landings Project

Building the World's Longest Floating Bridge

April 2017

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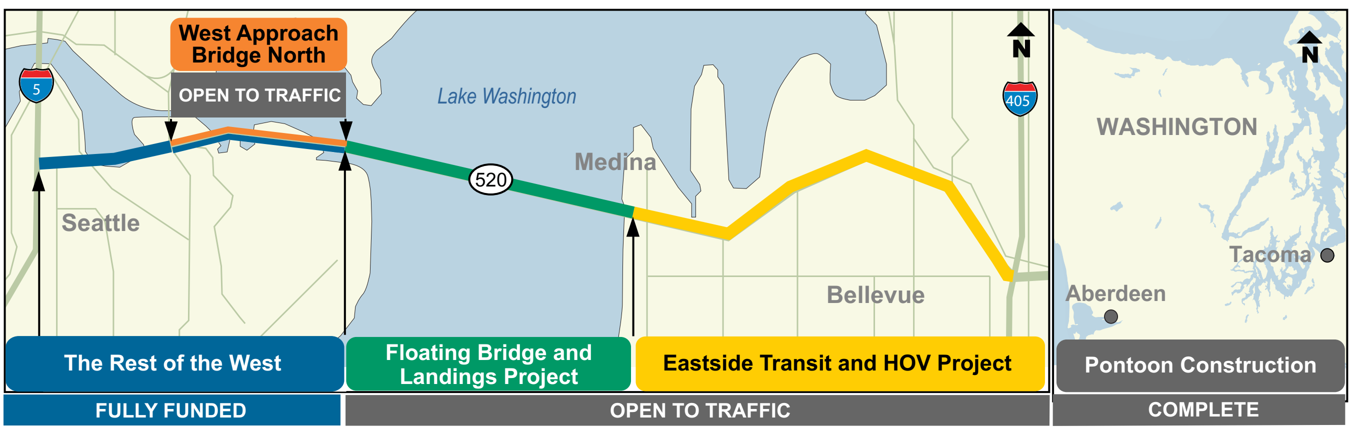
Introduction

Just as its predecessor did for more than a half century, the new, replacement State Route 520 floating bridge provides a vital social and commercial transportation link between Seattle and the growing, economically vibrant cities on the east side of Lake Washington. Just as importantly, the new bridge gives the region a safer and more reliable cross-lake route, with new, dedicated lanes for buses and carpools, and a separated path for nonmotorized travel between Seattle and the Eastside. At the time it opened in April 2016, the SR 520 floating bridge was named by Guinness World Records as the world's longest floating bridge.

The Floating Bridge and Landings Project was a central part of a larger, ongoing megaproject that is reconstructing approximately eight miles of the SR 520 corridor, from I-405 in Bellevue to I-5 in Seattle. Other now-completed phases of the larger SR 520 Bridge Replacement and HOV Program involved construction of floating-bridge pontoons in Aberdeen, Washington, and rebuilding the highway's Eastside segment between I-405 and Lake Washington's east shore.

When the corridor's reconstruction is fully completed in the late 2020s, all of SR 520's major bridges will be replaced, the bus/carpool lanes and a regional bicycle/pedestrian path will extend from I-5 east to Redmond, and travelers will have safer access ramps and improved connections to transit and local streets.



This online "booklet" provides a broad overview of the new floating bridge, touching on its design, construction, key structural features, financing and 2016 Grand Opening.

Overview of the SR 520 Floating Bridge and Landings Project

- The SR 520 Floating Bridge and Landings Project replaced the old SR 520 floating bridge, as well as its East Landing in Medina and a section of the old west approach bridge, east of Foster Island in Seattle.
- Construction on the SR 520 Floating Bridge and Landings Project began in early 2012, and the new bridge opened to traffic in April 2016.
- At 7,708.5 feet long, end to end, the new structure is the world's longest floating bridge. The old SR 520 floating bridge, 7,578 feet long, previously held that record.

Why did WSDOT replace the old SR 520 floating bridge and landings?

- After more than a half century of use, the old SR 520 floating bridge was showing its age. The bridge's pontoons were vulnerable to windstorms and its fixed approaches were vulnerable to earthquakes.
- Additionally, the old bridge had only two lanes in each direction, no shoulders and no bus/carpool lanes. Adding transit/HOV lanes, shoulders and a bicycle/pedestrian path provides greater reliability and more options to accommodate growth in the region.

View videos explaining WSDOT's rationale for replacing the old floating bridge, as well as videos of construction progress and more at *bit.ly/wsdotvids*.

The end result

- **A safer structure:** The new bridge has more than twice as many support pontoons, and they're bigger and heavier, making the bridge resistant to sustained winds up to 89 mph.
- **Improved transit reliability and travel times:** There are two general-purpose lanes and one transit/HOV lane in each direction.
- **Wider, safer shoulders that allow disabled vehicles to pull out of traffic:** Outer shoulders on either side of the bridge are 10 feet wide; the old bridge's outside shoulders were just 2 feet wide.
- **Ability to accommodate light rail if the region chooses to fund it in the future:** The new floating bridge is engineered to handle light rail by adding more supplemental pontoons.
- **A 14-foot-wide bicycle and pedestrian path on the north side of the bridge:** The path connects with local and regional trails in Seattle and the Eastside.

The new bridge has more than twice as many support pontoons.

A view of the new floating bridge just after it opened to traffic in April 2016.

The new bridge has a 14-foot-wide bicycle and pedestrian path.

Project timeline

The SR 520 Bridge Replacement and HOV Program has been in the works since 1997, when the Washington State Legislature funded a group to study the many options for transportation between the Eastside and Seattle. Over the next two decades, WSDOT worked with stakeholders on both sides of Lake Washington to define a "Preferred Alternative" and build the new floating bridge. Learn more about the environmental review process at *wsdot.wa.gov/Projects/SR520Bridge/Library/I5Medina.htm*.

Year	Progress
1997-2000	Trans-Lake Washington Study to evaluate long-term needs and options to cross Lake Washington
2000-2004	Trans-Lake Washington Project begins, which narrows options for crossing Lake Washington
Summer 2006	Draft Environmental Impact Statement (DEIS) published, identifying a preliminary range of design options
2009	Supplemental Draft Environmental Impact Statement (SDEIS) builds on the DEIS with a new set of six-lane alternative highway design options for public comment
Summer 2011	Publication of the Final Environmental Impact Statement, which evaluates the preferred alternative and responds to public comments received on the DEIS and SDEIS
Late 2011	Begin pontoon construction in Tacoma and Aberdeen
Early 2012	Begin anchor construction in Kenmore
Spring 2012	Begin bridge construction on eastern shore of Lake Washington
Spring 2016	New floating bridge opens to drivers
Spring 2017	Old floating bridge removed from Lake Washington

Key floating bridge facts

Bridge Dimensions	Old Bridge	New Bridge
Length	7,578 feet	7,708.5 feet
Number of standard travel lanes	2 each direction	2 each direction
Number of HOV lanes	0	1 each direction
Bicycle/pedestrian access	No	14-foot-wide shared-use path
Shoulder width	1 foot inside 2 feet outside	4 foot inside 10 feet outside
Roadway deck width (at midspan)	60 feet	116 feet
Deck height above water (at midspan)	6.5 feet	20 feet
West navigational channel clearance	44 feet	44 feet
East navigational channel clearance	64 feet	70 feet
Central drawspan	Yes	No drawspan
Date opened to traffic	August 28, 1963	April 11, 2016 (westbound) April 25, 2016 (eastbound)
Traffic volume	103,000 vehicles/day (pre-tolling)	77,000 vehicles/day (2016)
Sustained wind speeds built to withstand	57 mph; retrofitted for 77 mph	89 mph (100-year storm)
Expected service life	50+ years	75+ years
Number of pontoons	33	77
Size of biggest pontoons (longitudinal pontoons)	15 feet, 8 in. tall 60 feet wide 360 feet long 4,725 tons	28 feet tall 75 feet wide 360 feet long 11,000 tons

Bridge Dimensions	Old Bridge	New Bridge
Total bridge width (including pontoons)	60 feet	195 feet with stability pontoons; 240 feet at cross pontoons
Number of anchors (all types)	58 anchors	58 anchors
Size of fluke anchors	33 feet wide 16 feet, 9 in. tall 77 tons	35 feet wide 26 feet tall 107 tons
Size of gravity anchors	26 feet by 26 feet 13 feet tall 132 tons	40 feet by 40 feet 23 feet, 8.5 in. tall 420 tons

Ideas and engineering behind the SR 520 floating bridge

Why WSDOT built another floating bridge

A long history of floating bridges in Washington state

Washington state is the floating bridge capital of the world, with four of the five longest floating bridges. They are:

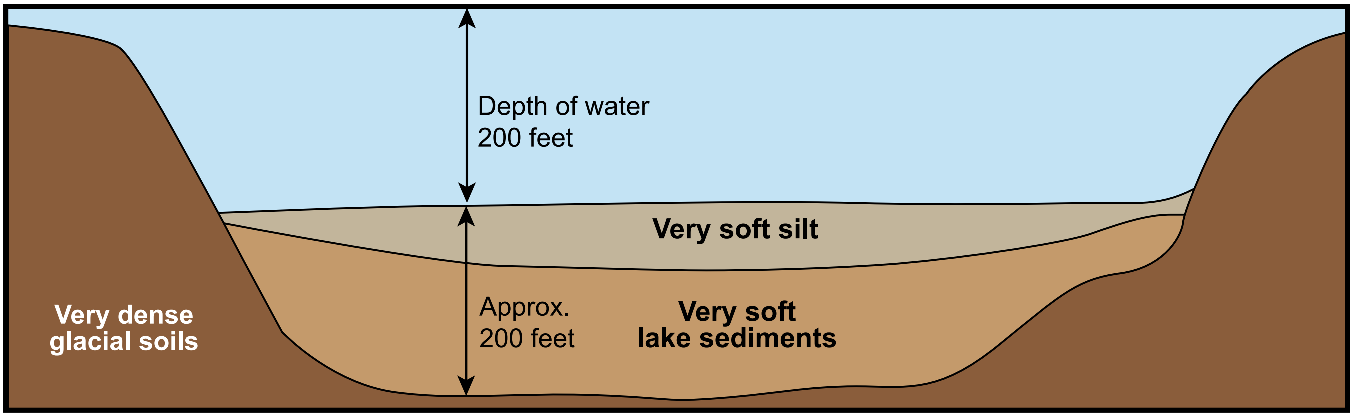
- SR 520 Gov. Albert D. Rosellini (Evergreen Point) Bridge (7,708 feet),
- I-90 Lacey V. Murrow Bridge (6,620 feet),
- SR 104 Hood Canal Bridge (6,521 feet),
- I-90 Homer M. Hadley Bridge (5,811 feet).

Construction of the old SR 520 floating bridge west approach on Lake Washington on March 20, 1962. Courtesy Seattle Municipal Archives (Image No. 70342). View more historical images at 520history.org

Floating bridges are not a uniquely Washington product. The Demerara Harbor Bridge in Georgetown, Guyana, is the world's fourth-longest floating bridge (6,074 feet). It is made of steel pontoons. Norway has two large floating bridges – the Bergsøysund Floating Bridge (3,054 feet) and the Nordhordland Floating Bridge (5,295 feet).

Our neighbors to the north also have constructed a floating bridge to fit unique environments. In 1957, a concrete floating bridge was built across Lake Okanagan at Kelowna in south central British Columbia, Canada. Its floating length is 2,100 feet, with a design very similar to the Lacey V. Murrow Bridge.

Lake Washington's topography



WSDOT chose to build a floating bridge instead of a more conventional fixed or suspension bridge in part because of the unique natural features of Lake Washington:

- The deepest point in Lake Washington is 214 feet deep, and the bridge's support towers would have to be approximately 630 feet in height, nearly the height of the Space Needle, to support the bridge. These massive towers would be out of character with the surroundings because they would create more noise and block views.
- Conventional fixed bridges, such as the Tacoma Narrows Bridge, are expensive to build in deeper waters with soft beds, such as Lake Washington.
- Suspension bridges need to travel in a fairly straight line. Because SR 520 is a curved corridor, a suspension bridge would not be possible.

How floating bridges work

How windstorms and waves affect floating bridges

Waves batter the old SR 520 floating bridge – and traffic – during a storm.

Wind and wave forces are typically the controlling forces in the design of floating bridges. A major factor in wind and wave effects on floating bridges is called the fetch. The fetch is the unobstructed clear distance over the water that wind can travel to the bridge. The longer the fetch, the higher the wind and wave forces will be. In Lake Washington the critical fetch is to the southwest of the bridge, since the largest storms historically come from the southwest. Wind and wave forces cause the pontoons to bend, heave and twist, creating large stresses in the pontoons and anchor system. If a 100-year storm event were to occur, the pontoons are designed to prevent large cracks from developing that would allow water to leak in and sink the bridge.

How earthquakes affect floating bridges

In the case of the SR 520 floating bridge, its floating section is not affected directly by ground shaking from an earthquake because the bridge is composed of pontoons anchored to the bottom of Lake Washington. However, earthquakes can cause a seiche wave, a surface wave similar to a tsunami. A seiche in Lake Washington could cause the floating bridge to bend and heave at the lake surface, adding large loads of pressure to the pontoons and anchor systems. A seiche in Lake Washington could also create an underwater landslide that could cause the pontoon anchors to slip or break. Typically, though, the waves from a seiche create less stress on the pontoons than wind-induced waves from a storm that occurs once every 100 years.

How floating bridges are constructed

Individual bridge pontoons are usually built on dry land next to a waterway, then floated and towed like barges to the bridge site. They are connected to grounded approach structures on each end, starting at the edge of the floating structure and then pieced together toward the eventual bridge's center. The pontoons are held in place by enormous steel cables, generally hundreds of feet long, that are connected to anchors buried deep in the lakebed.

How floating bridges float

Floating bridges are made of large, watertight concrete pontoons connected rigidly end to end, upon which the roadway is built. Despite their heavy concrete composition, the weight of the water displaced by the pontoons is equal to the weight of the structure (including all traffic), which allows the bridge to float.

Construction of the new floating bridge

The new SR 520 floating bridge is the longest floating bridge in the world. Building a bridge that sits on the water comes with several highly unusual construction challenges as well as a few advantages.

Construction locations

Construction of the SR 520 Floating Bridge and Landings Project took place in several locations. Assembling the bridge and connecting it to the rest of SR 520 happened between the west and east shores of Lake Washington in Seattle and Medina.

Construction activities for the new floating bridge took place in four locations across Western Washington. Building the bridge's components in Grays Harbor, Tacoma and Kenmore, then assembling the bridge on Lake Washington, provided more than a thousand jobs in the region.

The largest pontoons were towed from Grays Harbor to Lake Washington. These pontoons were constructed in Aberdeen as part of a separate contract.

We built 44 supplemental stability pontoons in Tacoma.

We also built bridge anchors and hundreds of precast roadway deck sections in Kenmore.

All of these components were floated to and assembled on Lake Washington to form the new SR 520 floating bridge.

Kenmore

Kiewit/General/Manson, A Joint Venture (KGM), the design-build contractor for the SR 520 Floating Bridge and Landings Project, built gravity anchors, fluke anchors and other precast concrete components in Kenmore. In August 2014, KGM completed construction of all 58 anchors needed for the new floating bridge, and completed final construction and placement of all 776 precast roadway deck sections in August 2015. These sections form the roadway for the new floating bridge. See the "Structural Components" section of this booklet for a photo of a precast deck section being placed.

Tacoma

Construction of the 44 supplemental stability pontoons built in Tacoma was completed in December 2014. These pontoons are attached to the larger longitudinal pontoons to provide additional stability and buoyancy (see the Pontoon section below for more information about the supplemental pontoons).

Aberdeen

The Pontoon Construction Project broke ground in February 2011 at a 54-acre site in Aberdeen. WSDOT and contractor Kiewit-General (K-G) built a casting basin facility featuring a concrete batch plant, on-site water treatment, and a 4-acre casting basin, in order to stage construction of 33 pontoons.

The new bridge's largest pontoons are its 21 longitudinal pontoons. All built in Aberdeen, they later were joined together end to end on Lake Washington to form the backbone of the new floating bridge. The largest pontoons ever built in Washington, these pontoons are 360 feet long, 75 feet wide, nearly 30 feet tall, and weigh 11,000 tons. All told, the pontoon construction in Aberdeen required 112,000 cubic yards of concrete, 35,000 tons of steel rebar, and 2.7 million square feet of plywood formwork.

Crews in Aberdeen also built 10 of the new bridge's supplemental stability pontoons, along with its two cross (or end) pontoons. The 33 pontoons constructed in Aberdeen were built in six cycles of around six to eight pontoons at a time. Once complete, each batch of pontoons was floated out of the casting basin, inspected, and then towed to Lake Washington. The final three pontoons that constituted the sixth and final pontoon cycle were floated out of the casting basin on March 9, 2015. They were towed to Lake Washington by tugboat and arrived on April 9, 2015.

The Grays Harbor pontoons were constructed under a separate contract from the Floating Bridge and Landings Project. More information about the Pontoon Construction Project can be found at *www.wsdot.wa.gov/Projects/SR520/Pontoons.htm*

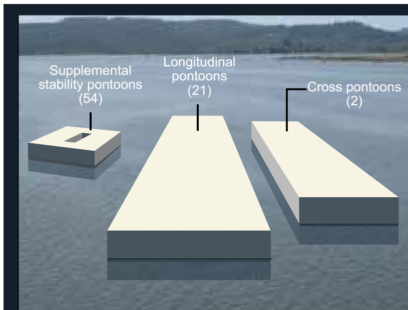
Kenmore construction site

Tacoma construction site

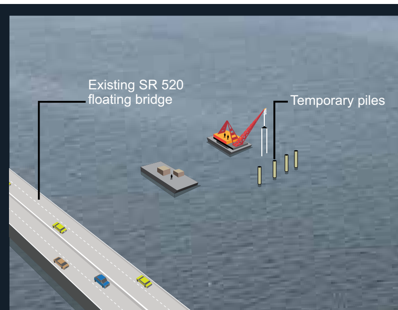
Aberdeen construction site

Construction overview

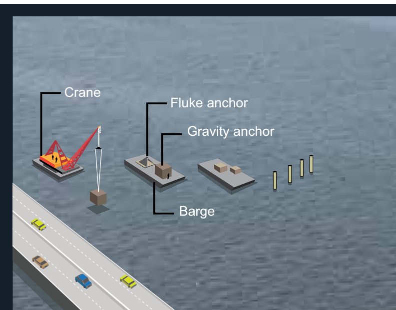
The following images describe how the new floating bridge was built. Images are for illustrative purpose only and are not to scale.



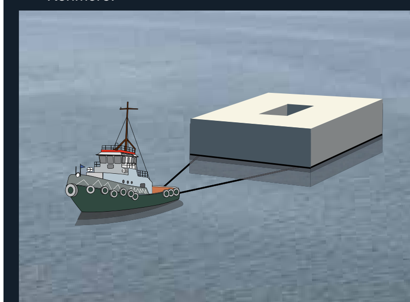
1 Build the necessary pontoons, anchors and roadway sections in Aberdeen, Tacoma and Kenmore.



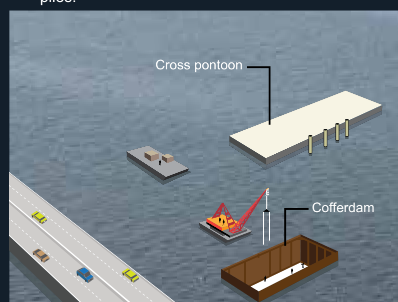
2 Begin constructing staging area near Medina with construction barges and cranes. Drive temporary piles.



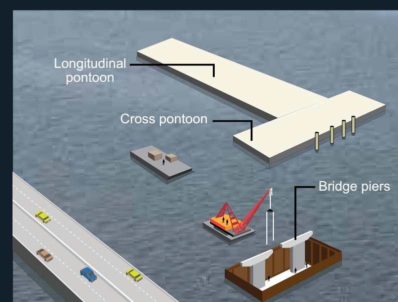
3 Install anchors for the floating bridge.



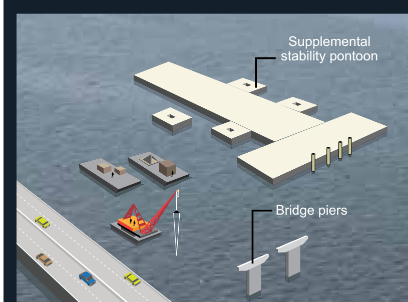
4 Tow pontoons to Lake Washington.



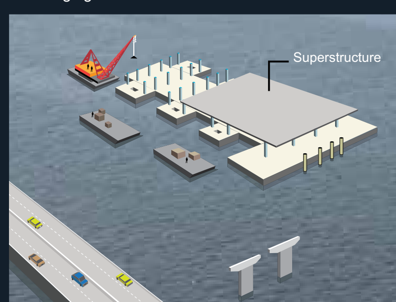
5 Install cofferdams to build bridge piers for East Approach structure. Move cross pontoon into staging area.



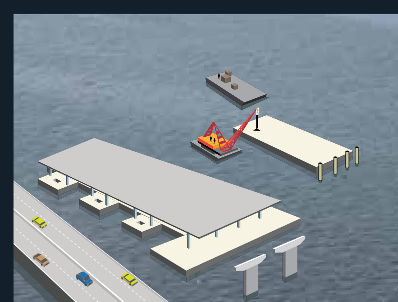
6 Build bridge piers in cofferdams and begin pontoon assembly in staging area.



7 Join supplemental pontoons to longitudinal pontoons at staging area.



8 Begin installation of superstructure on pontoons at staging area.



9 Move completed pontoons into position on Lake Washington. Continue assembling pontoons in staging area.

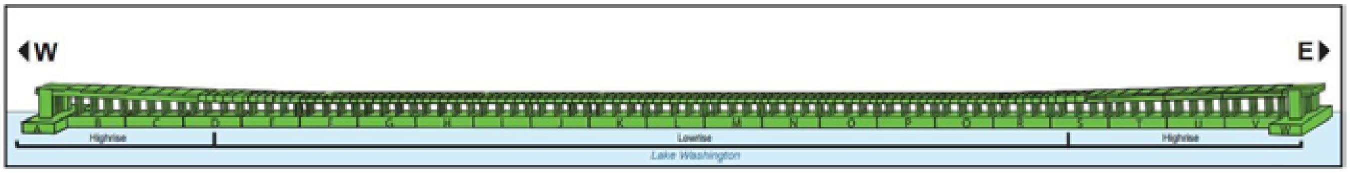
10 Move completed pontoons into position on Lake Washington and complete roadway superstructure.

11 Connect new floating bridge to completed East Approach and west transition span.

12 Shift traffic to new floating bridge. Decommission the existing bridge and remove from Lake Washington.

Floating bridge pontoons

The entire bridge structure is kept afloat by 77 concrete pontoons. The pontoons are aligned in the configuration shown in the graphic below and are labeled alphabetically from west to east.



View a larger version of the floating bridge assembly graphic at *bit.ly/bridgeassembly*

Types of pontoons

The new SR 520 floating bridge is supported by three types of concrete pontoons: supplemental stability pontoons, longitudinal pontoons, and cross pontoons.

Longitudinal pontoons

These are the largest pontoons at approximately 360 feet long. They form the backbone of the bridge and support the roadway superstructure.

- The floating bridge has 21 longitudinal pontoons
- Constructed in Aberdeen facility
- Weight: 11,100 tons

Cross pontoons

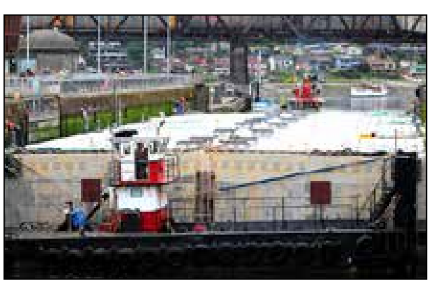
Cross pontoons mark the ends of the floating bridge and the transition to the east and west approach structures.

- There are two cross pontoons, one at either end of the floating bridge
- Constructed in Aberdeen facility
- Weight: 10,100 - 10,550 tons

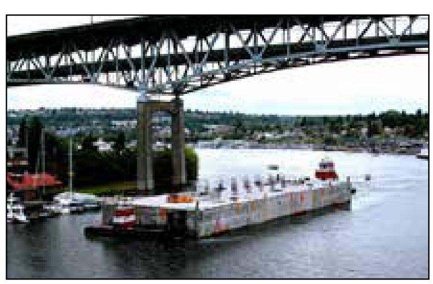
Supplemental stability pontoons

These smaller pontoons, when joined to the larger longitudinal pontoons, help stabilize and support the weight of the new floating bridge.

- The bridge has 54 supplemental stability pontoons
- Constructed in Aberdeen facility (10) and Tacoma facility (44)
- Weight: 2,500 - 2,820 tons



Longitudinal pontoons



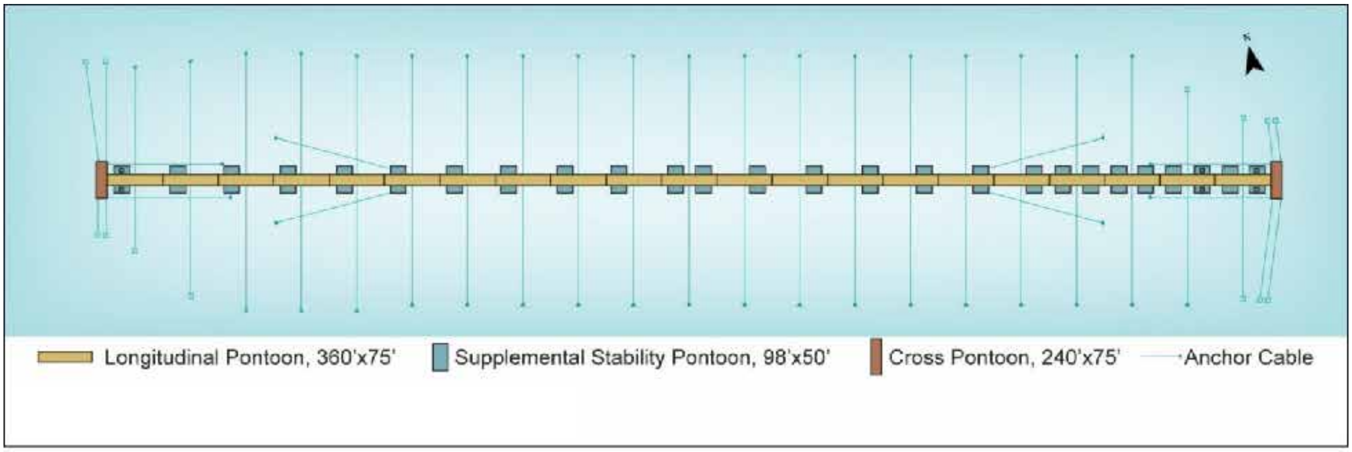
Cross pontoons

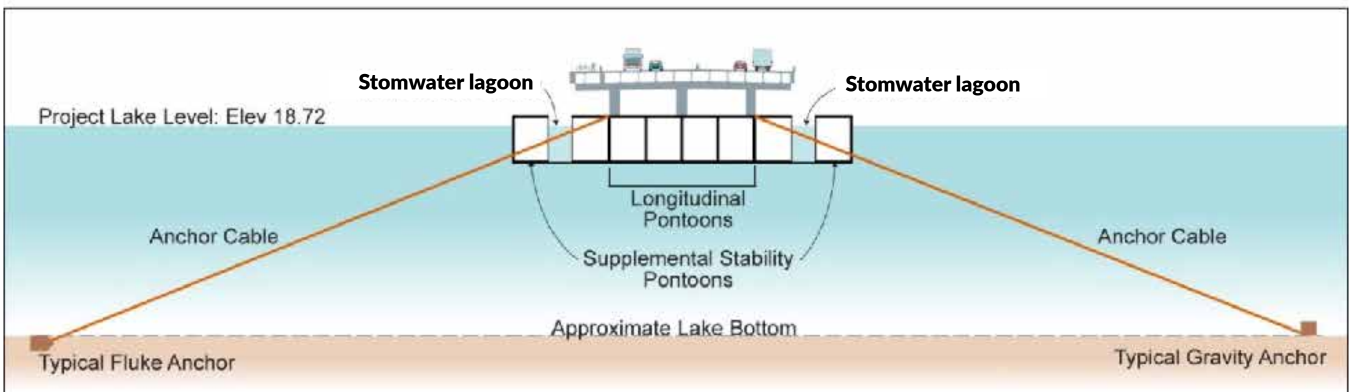
Supplemental stability pontoons

Bridge anchors and cables

Pontoons supporting the new SR 520 floating bridge are held in place by a series of woven steel cables. The cables, 3 1/8 inches thick and up to 1,000 feet long, are connected to three different types of anchors on the Lake Washington lakebed.

Bridge cable configuration





Bridge Cross Section and Anchor System

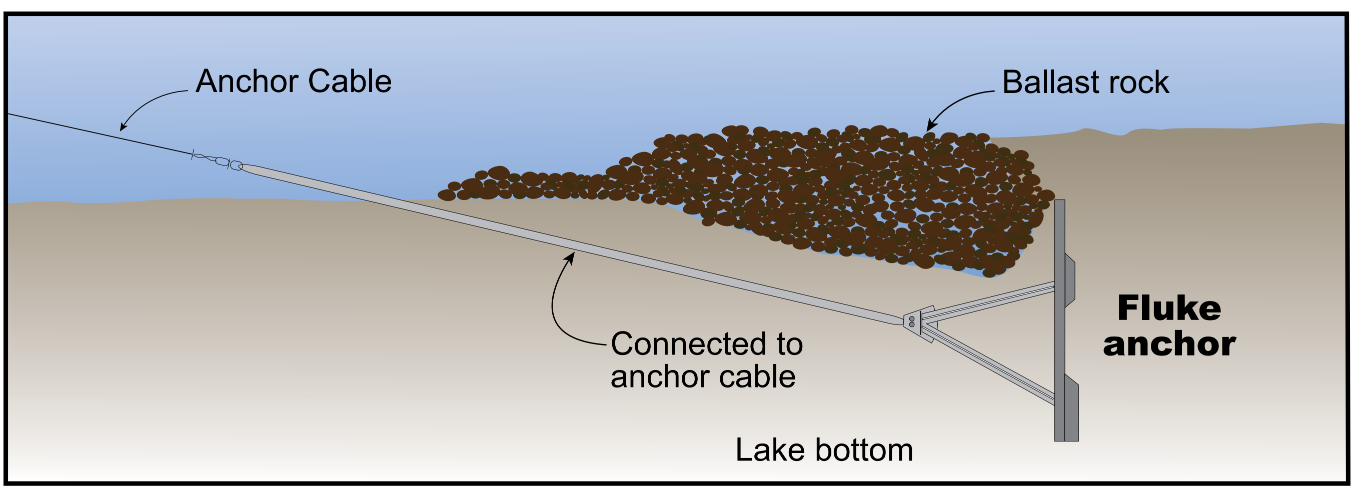
Types of anchors

Three different types of anchors secure the new bridge from shifting during wind and wave action. These types are fluke anchors, gravity anchors, and drilled shaft anchors.

Fluke anchors

- Dimensions: 35 feet x 26 feet x 17.5 feet
- Weight: 107 tons
- Quantity: 45
- Locations: Deep, soft soils of the lakebed and flat areas
- Manufactured: Kenmore

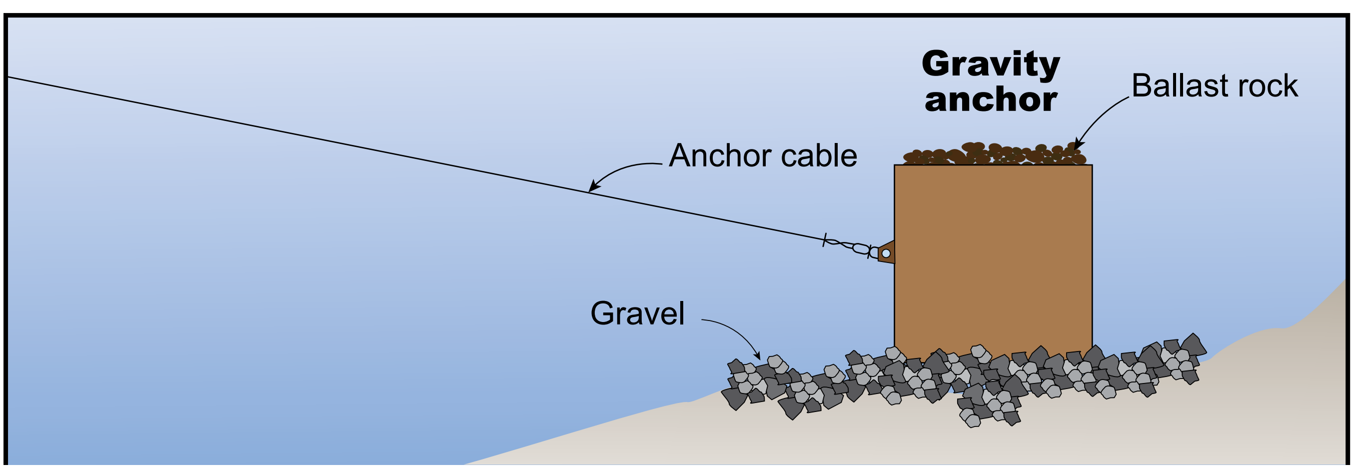
Completed fluke anchors are barged from Kenmore to the bridge-assembly site on Lake Washington. The graphic below shows how fluke anchors are placed in the lakebed.



Gravity anchors

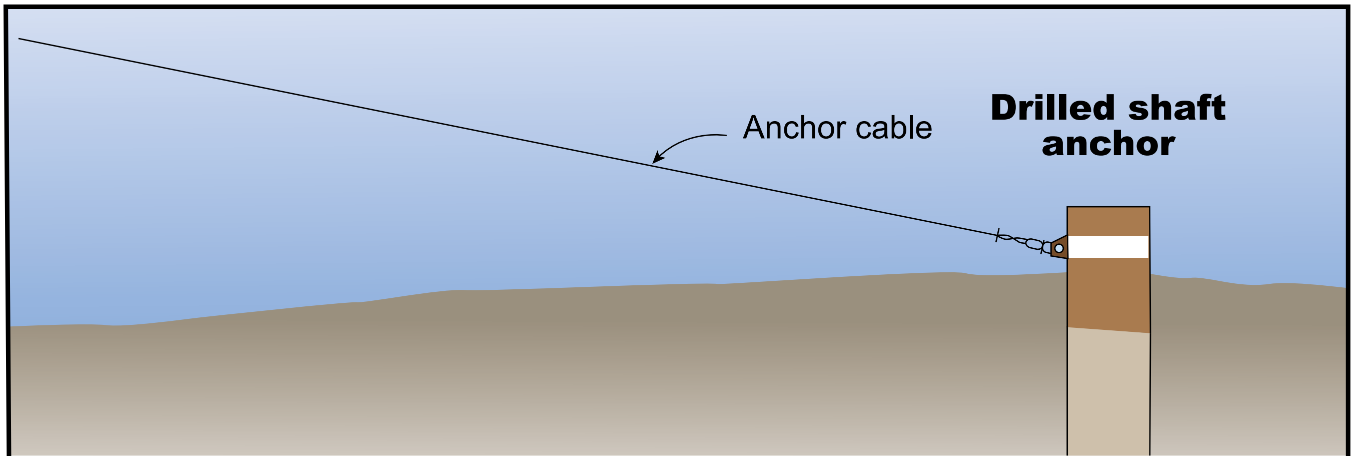
- Dimensions: 40 feet x 40 feet x 23 feet
- Weight: 420 tons as built, 587 tons fully loaded
- Quantity: 8
- Locations: Solid soils with sloped topography, typically near shore. Underwater grading and installation of gravel creates a level footing for anchor placement.
- Manufactured: Kenmore

Workers aboard a derrick barge lower a 420-ton gravity anchor into Lake Washington.



Drilled shaft anchors

- Dimensions: 10-foot-diameter drilled shaft, 79 to 92 feet long
- Quantity: 5
- Locations: Solid soils near shore where gravity anchors may cause navigation hazard.
- Manufactured: Concrete cast in place from a barge on Lake Washington.

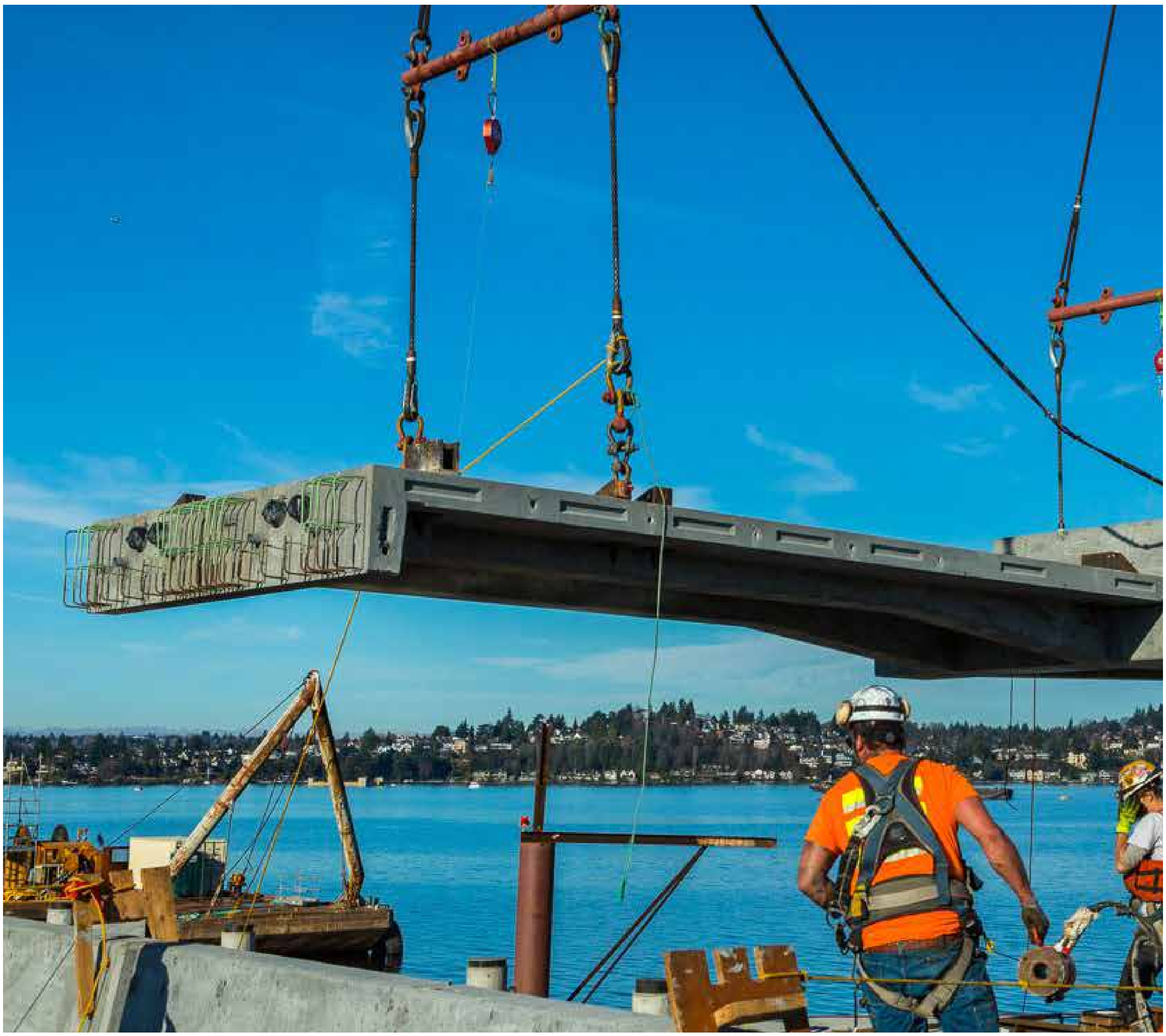


Other bridge components

Electrical components

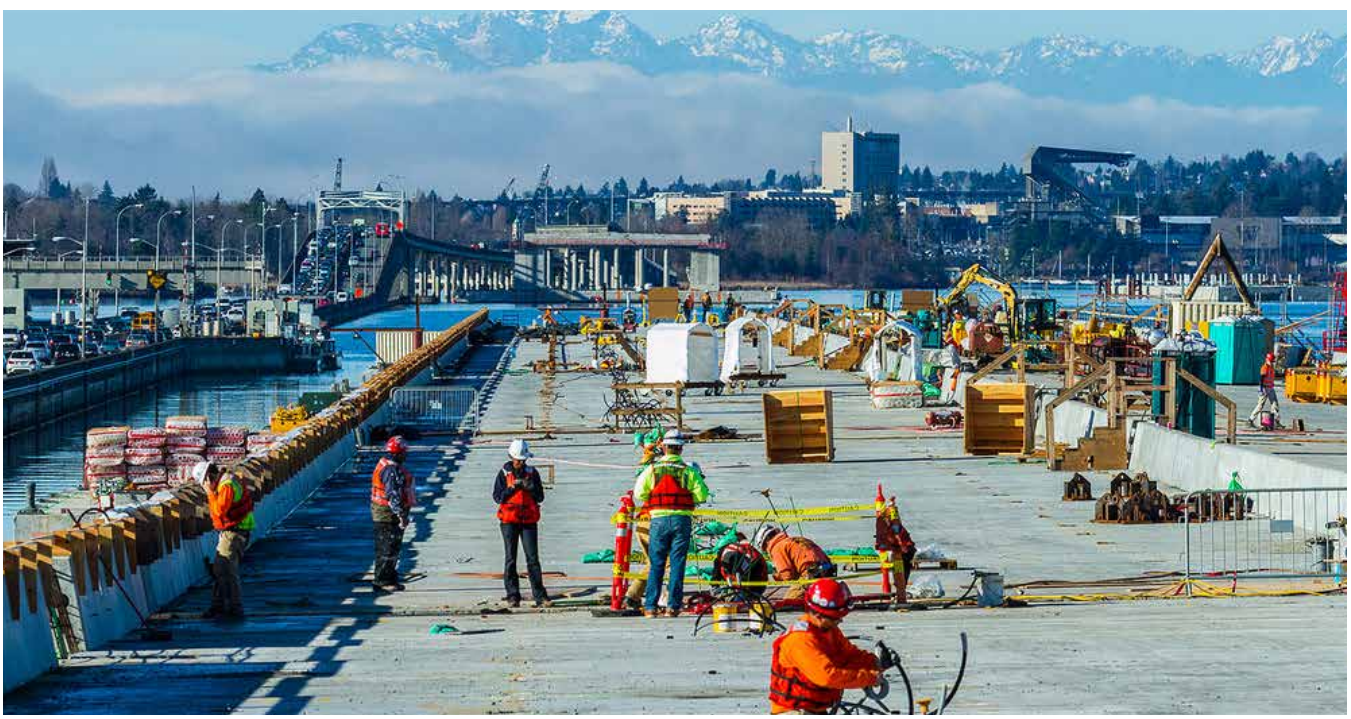
Crews installed more than 300 miles of electrical wire and various electronic components and sensors along the bridge's entire length -- all electronically linked both to a new bridge maintenance facility in Medina and to WSDOT's northwest regional traffic-management center in Shoreline.

Structural components



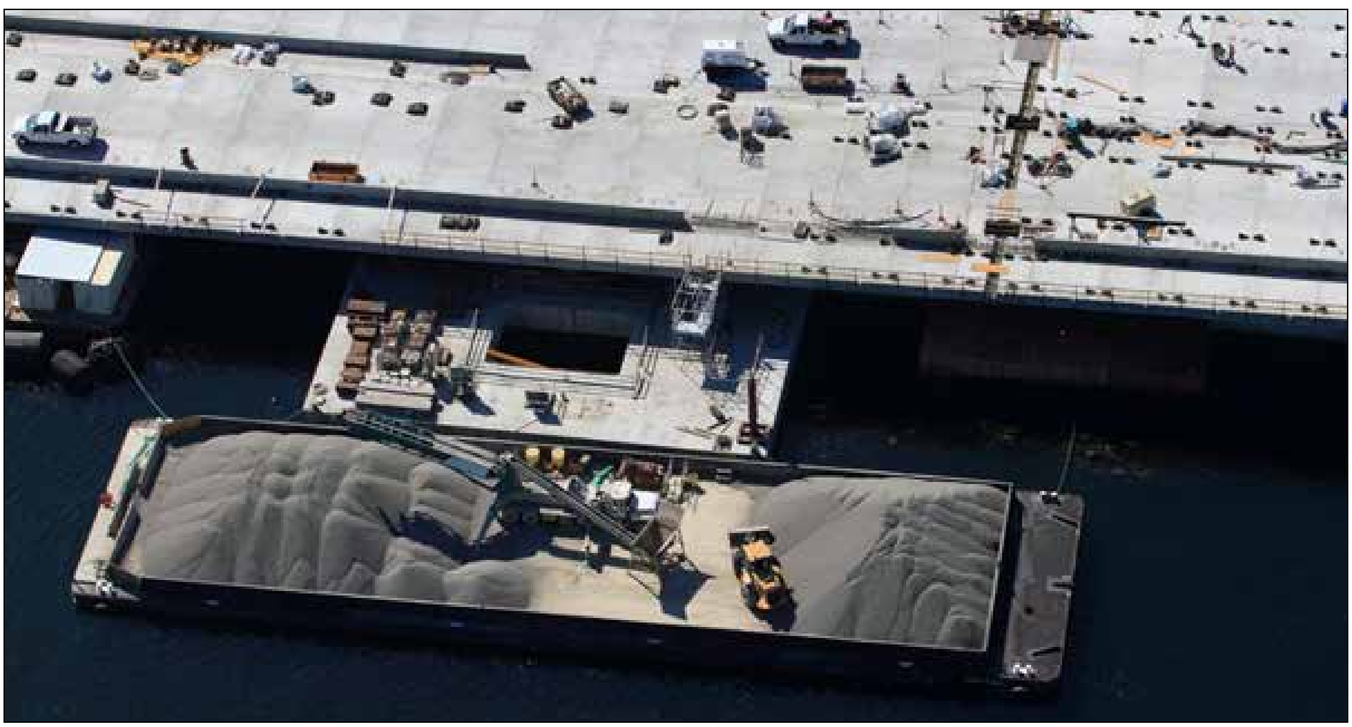
Roadway deck: There are 776 precast deck panels that constitute the low-rise roadway deck. These panels were constructed in Kenmore. The high-rise roadway deck includes 23 cast-in-place deck spans, and four additional cast-in-place spans placed on the transition spans between floating and fixed sections of the bridge.

Deck support: The bridge deck is supported by 771 concrete columns and 331 concrete girders, large beams that the bridge deck rests upon.



Bridge barrier: There are 25,846 feet of barrier installed along the length of the bridge. The barriers separate the highway's eastbound and westbound lanes, as well as the new regional shared-use path.

Noise walls: To minimize traffic noise in nearby areas, crews constructed 1,600 feet of noise walls along the north and south sides of the bridge in Medina.

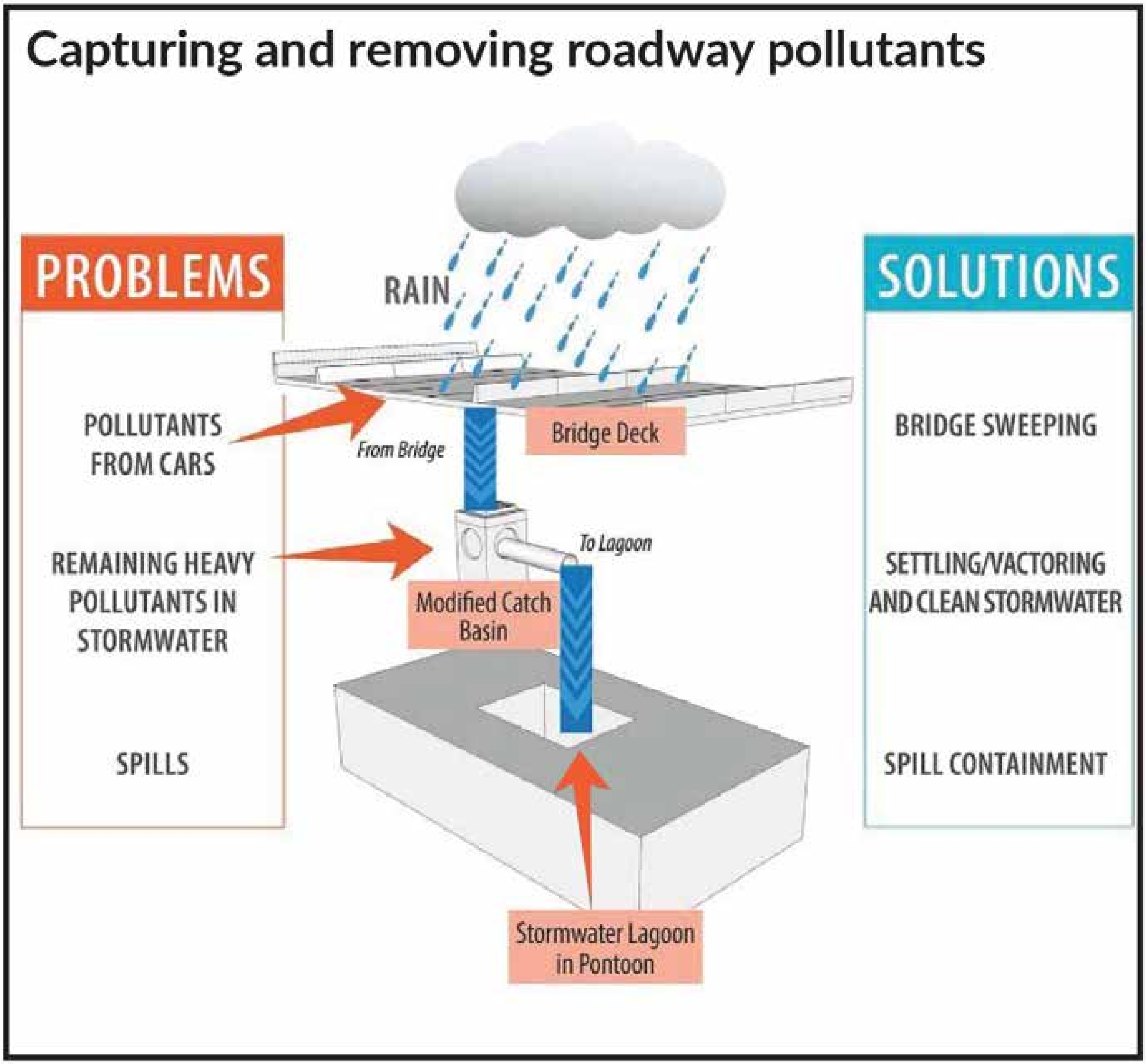


Ballast: Pontoons float at their appropriate height due to 75,000 tons of ballast rock placed inside them.

Bridge maintenance facility and dock: A LEED-certified bridge maintenance facility and dock under the east approach of the bridge give maintenance staff improved access to the floating bridge.

Fire safety systems: Pipes, hydrants and pumps installed for the fire safety system provide firefighters with water to extinguish a fire if one should occur on the bridge.

Static and active traffic management systems: Modern traffic signage and electronic speed-limit notifications keep traffic flowing, with 105 new traffic signs and gantries installed.



Stormwater drainage: The new bridge's innovative stormwater system entails 15,450 feet of piping, catch basins and "lagoons" within the supplemental pontoons to collect, filter and properly dispose of pollutants in roadway runoff.

Safety and security systems: The new floating bridge has state-of-the-art safety and security systems, including cameras on both the pontoons and the roadway that allow crews to monitor traffic on the bridge, and activity on the pontoons. In addition, each pontoon is individually monitored with high-tech float switches that notify the nearby maintenance facility of any water intrusion into the pontoons.

Sentinels: Four sentinels mark the transition between the floating bridge and its fixed approaches at the east and west ends. The LED lights in the sentinels feature numerous color options.

Railing: The bicycle and pedestrian path has 8,425 feet of specially designed railing to both keep people safe and allow unrestricted views of north Lake Washington.

Belvederes: These rest stops along the new regional shared-use path provide scenic viewpoints and informational displays for bicyclists and pedestrians.

Roadway grinding: The 34,580 square feet of roadway on the floating bridge features Next Generation Concrete Surface grind – grooves in the pavement to reduce traffic noise. Learn more about quieter concrete research in Washington state at *www.wsdot.wa.gov/Business/MaterialsLab/QuieterPavement/*

Approach bridges: This photo shows the two east approach bridges – one for westbound traffic, one for eastbound traffic – that connect to the new floating bridge near Medina. WSDOT also is building two new west approach bridges between the floating bridge and Seattle.

Medina viewpoint: One of the final tasks on the Floating Bridge and Landings Project was construction of a pedestrian trail and lakeside viewpoint in Medina, shown here just south of the bridge.

How the floating bridge connects to land

A transition span connects the movable, floating bridge to the stationary, elevated bridge segment at the east approach. The transition span is made up of girders, each 190 feet long and 45 tons. On either end of the span, hinges allow the transition span to move up to 24 inches up and down or side to side to accommodate varying lake water levels.

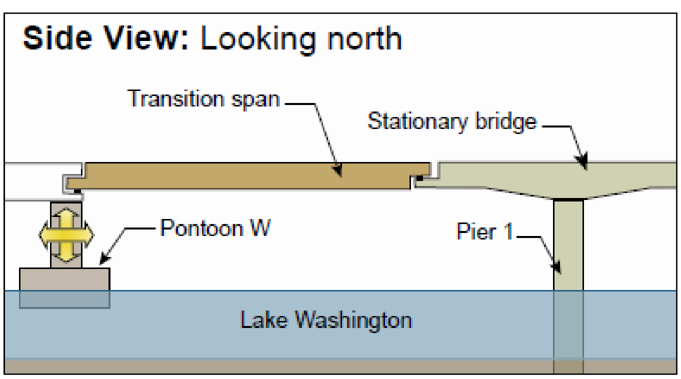
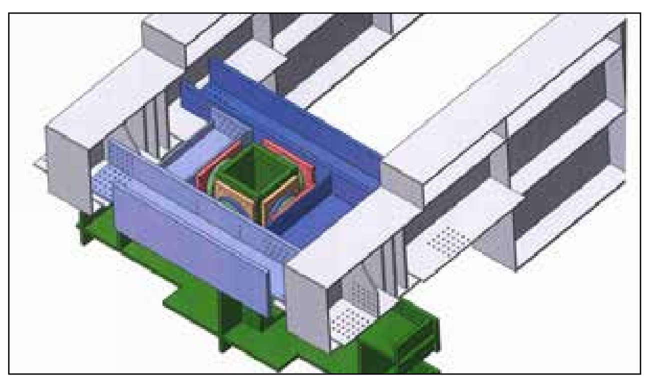


Illustration of how the transition span fits between the floating and stationary bridges. View a larger graphic at bit.ly/TransSpan



This "trailer hitch" joint allows for motion and roll in all directions while holding the transition span in place.

The Grand Opening

The new floating bridge opened to traffic in April 2016 after five years of construction and more than a dozen years of planning, studies, design, and community outreach. To celebrate the completion of the newest and longest floating bridge in the world, WSDOT hosted a celebration for the public to experience the new structure just before it opened to traffic. The Grand Opening celebration (branded GO Long!) was held on April 2-3, 2016. More than 50,000 people participated.

GO Long! was staged as a fun, family-friendly event that also had an educational component. To that end, the event highlighted the extensive science, technology, engineering and math (STEM) involved in designing and building the bridge (Appendix Three contains the Grand Opening's informational display boards).

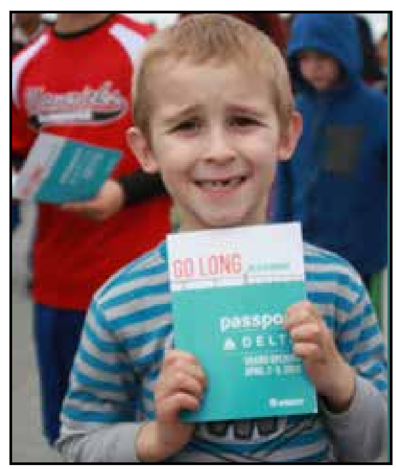
This Grand Opening illustration by WSDOT graphic artist Tuan Chau was featured on the event's promotional materials. View more Grand Opening photos at bit.ly/520GOphotos

Grand Opening activities

The GO Long! celebration included:

- A 10k run/walk event on the bridge that kicked off the celebration.
- A 20-mile bike ride featuring the SR 520 corridor, coordinated with the Cascade Bicycle Club.
- Continuous ribbon cutting: At both ends of the bridge, participants had the opportunity to cut a specially designed GO Long! ribbon as a keepsake, and pose for photos.
- Passport to the Bridge: Each guest received a Delta-sponsored Passport to the Bridge, which led them through each activity area to get a passport stamp, and presented a chance to win Delta Air Lines tickets.
- STEM activities: Kids of all ages experienced the STEM behind the construction and maintenance of the floating bridge, with activities highlighting stormwater treatment, Build-A-Bridge components and equipment, a deep-water diving team, a corridor driving simulator, and more.

Leading up to the Grand Opening, people engaged with the event through a “Name the Street Sweeper” contest and a photo contest on social media. (“Broom Hilda” was the winning name.) At the conclusion of the weekend of events, more than 30,000 people had attended the public celebration, 13,500 runners and walkers joined for the fun run, and 7,000 cyclists participated in the Ride the Bridge event.



Ribbon cutting

WSDOT also recognized the local leaders, tribes, and workers who played key roles in the planning, design, funding, and construction of the new SR 520 corridor. The SR 520 corridor travels through nine local jurisdictions, four legislative districts and two congressional districts, and constructing the corridor required cooperation and coordination with hundreds of stakeholders. Over 200 VIPs and their guests joined former Gov. Gary Locke and current Gov. Jay Inslee at the official bridge dedication and ribbon-cutting ceremony, during which the bridge was recognized by a Guinness World Records representative as the world's longest floating bridge.

Bicycle and pedestrian path

The first completed segment of the new SR 520 regional shared-use path opened in early 2015 between 108th Avenue Northeast in Bellevue and the highway lid at Evergreen Point Road. In July 2016, the path extended west from the lid and onto the floating bridge as an out-and-back route. The path extended across Lake Washington to Seattle in late 2017. As SR 520 construction proceeds in Seattle on the Rest of the West elements, it eventually will reach I-5. On the Eastside, the path connects to a city of Bellevue trail that runs under I-405 and hooks up with the old SR 520 trail to downtown Redmond. View more information on biking the SR 520 corridor at *bit.ly/520bikeped*.

The path gives users connections to local and regional trails and transit stops on both sides of Lake Washington, creating additional commuting and recreation opportunities.

On the new floating bridge, the 14-foot-wide, cross-lake trail includes belvederes to provide scenic viewpoints and resting areas for bikers, joggers and walkers. The path also has knee-level lighting all the way across the bridge, a protective barrier between the path and adjacent traffic, and a specially designed railing that provides views of the lake while keeping foot-powered travelers safe. Bicyclists and pedestrians do not pay a toll to cross the bridge.

Decommissioning the old SR 520 floating bridge

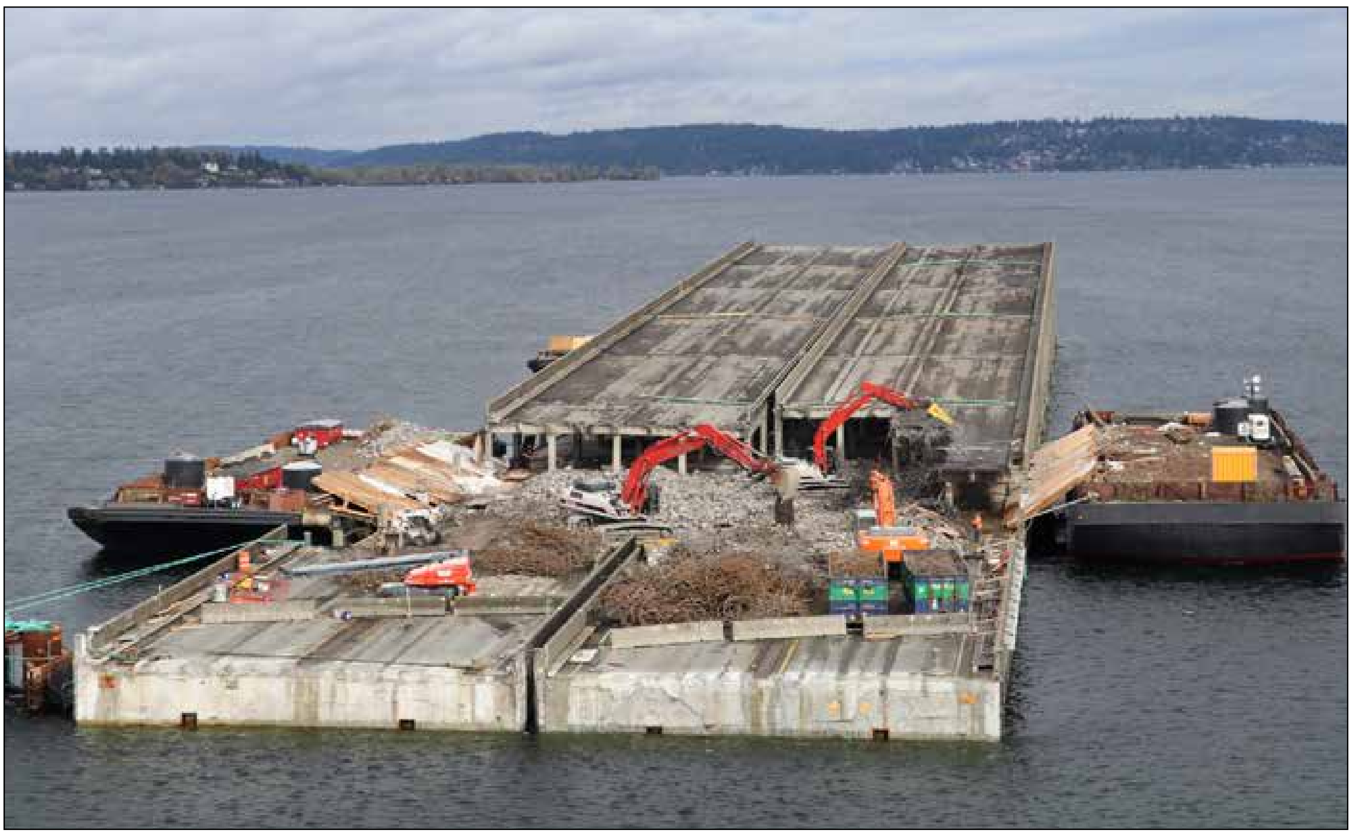
After the floating bridge opened to traffic in April 2016, Kiewit/General/Manson, A Joint Venture (KGM) immediately began to remove the old SR 520 floating bridge from Lake Washington. The work continued until spring 2017.

In order to remove the old bridge from Lake Washington, KGM did the following:

- Broke up and removed the old bridge roadway deck and barriers
- Removed the east and west transition spans
- Removed pier columns
- De-tensioned and separated old pontoons
- Moved the old pontoons from their original locations to staging areas on the lake for further dismantling of components on top of the pontoons
- Removed old anchor cables

Between July 2016 and January 2017, all 31 of the old bridge's pontoons were towed from Lake Washington through the Hiram M. Chittenden Locks in Ballard. The pontoons were kept intact and were sold to TrueNorth Operations Group. In the past, TrueNorth has converted used pontoons into docks, artificial reefs, and wharfs.

Other old bridge materials were dismantled and recycled. Some materials were dismantled on barges on Lake Washington, while others were dismantled on land. The majority of the bridge materials were hauled to concrete recycling facilities, where most of the materials were processed for reuse as dry aggregate for paving projects.



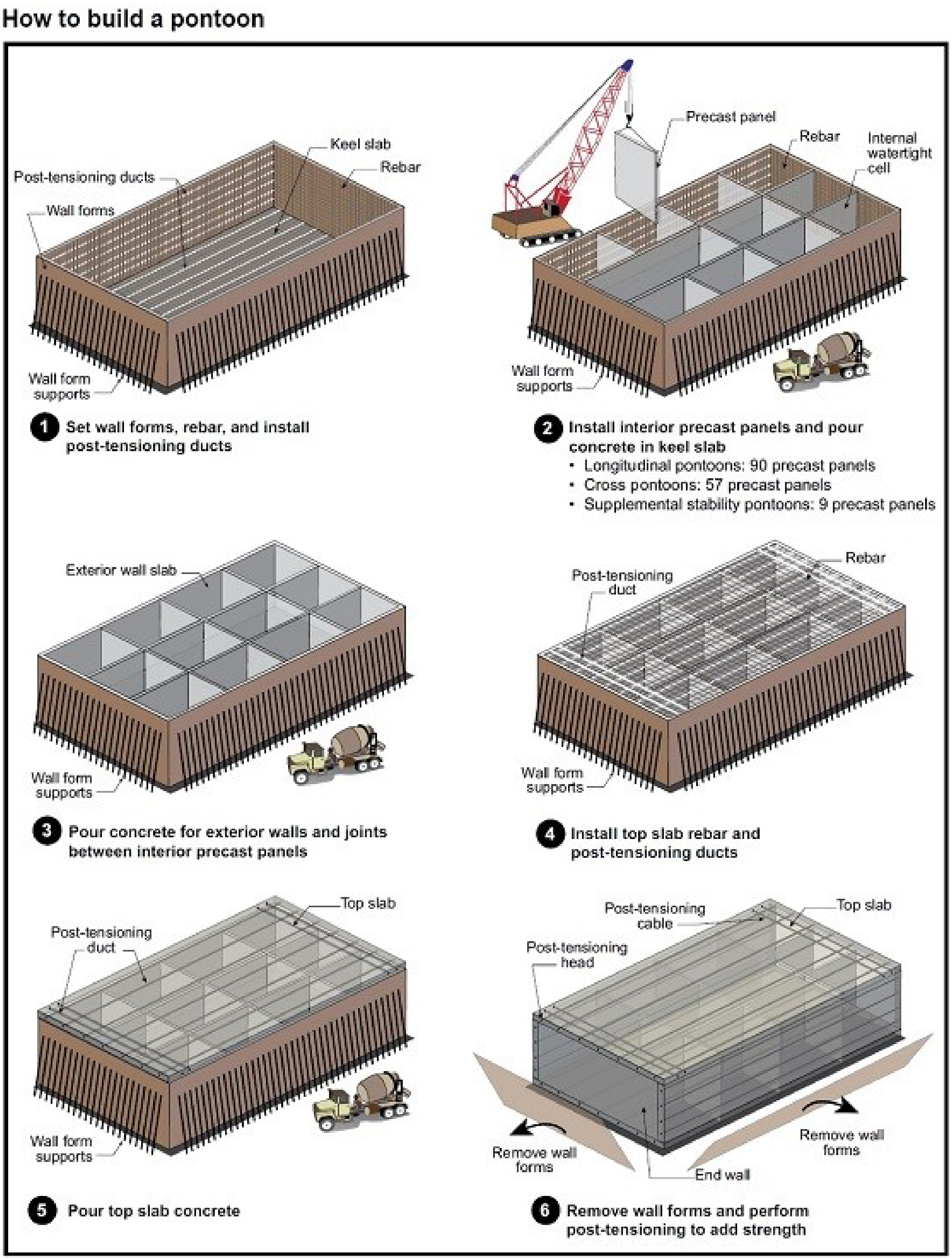
How can I get more information?

E-mail: SR520bridge@wsdot.wa.gov

Twitter: @WSDOT_520

Mail: **Washington State Department of Transportation**
SR 520 Bridge Replacement and HOV Program
999 3rd Avenue, Suite 2200
Seattle, WA 98104

Appendix one: Pontoon construction and repairs



In May 2012, cracking was discovered in one of the first pontoons built for the new SR 520 floating bridge. Action was immediately taken to modify the pontoons and ensure their 75-year design life.

The pontoons for the floating bridge were constructed during six separate construction periods, or cycles. All told, four of the Cycle 1 pontoons had to be repaired, while the design for four of the Cycle 2 pontoons was modified to prevent future cracking issues.

This coffer cell was used to make in-water repairs of two Cycle 1 pontoons.

May - June 2012

Cracking is discovered in one of the Cycle 1 pontoons constructed in Aberdeen. WSDOT begins repairs on the affected pontoon and preemptive modifications on the other longitudinal pontoons. WSDOT then convenes a panel of experts to review the repairs, analyze the cause of pontoon cracking, and make recommendations for future pontoon construction cycles.

July 2012

The pontoon review panel endorses the repairs to the pontoons, and the pontoons are towed to Lake Washington.

August 2012

The pontoon review panel submits a report to WSDOT that reviews the repairs made on Cycle 1 pontoons and addresses the causes of the cracking. The panel also makes recommendations to correct pontoon spalling and cracking. The causes named by the panel include:

- The placement and location of post-tensioning ducts contributed to concrete spalling.
- Resistance to post-tensioning from interior precast walls caused end walls to crack.
- All quality assurance practices need to be fully implemented to monitor a variety of concrete properties, including concrete shrinkage, curing and thermal controls, and water/cement ratios, as well as length of wall pours.

Later in August, inspectors find water leaking between two cells in Pontoon V. The water had been used as ballast to keep the pontoon at a certain height on the water. The leak is repaired.

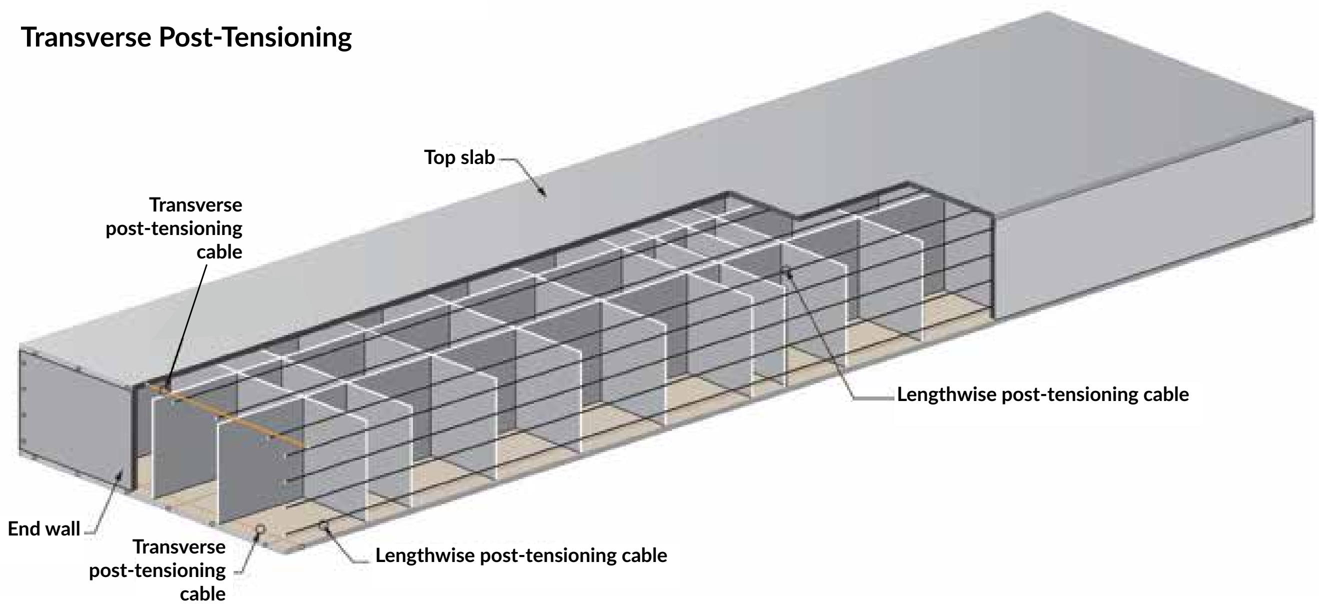
Inspectors also find moisture inside an end wall in Pontoon W.

February 2013

The pontoon review panel completes new recommendations on the pontoon cracking. The panel was reconvened in fall 2012 to review pontoon structural sufficiency, repairs to the existing pontoons, future options to reduce cracking, and long-term maintenance of the floating bridge.

Based on the findings of the expert review panel, WSDOT adds transverse post-tensioning to all longitudinal pontoons. Post-tensioning is a process where steel tendons are stretched through the top and bottom slabs and walls of the pontoons through a series of ducts to compress and strengthen the concrete. In Cycle 1, the longitudinal pontoons were post-tensioned lengthwise only. Adding transverse post-tensioning across the ends of the pontoons will help close cracks in the longitudinal pontoons' end walls, particularly at the keel and top slabs.

Transverse Post-Tensioning



Crews retrofitted the Cycle 1 pontoons on Lake Washington with transverse post-tensioning and added transverse post-tensioning to the Cycle 2 pontoons under construction. Transverse post-tensioning was incorporated into the remaining longitudinal pontoons to be constructed.

July 2013

Pontoon W, a Cycle 1 pontoon, is floated to Harbor Island in Seattle for repairs at a Harbor Island dry dock.

September 2013

Repairs to Pontoon W are completed. Pontoon W is then floated to the Duwamish River, where six columns will be replaced due to shifting that occurred during a concrete pour.

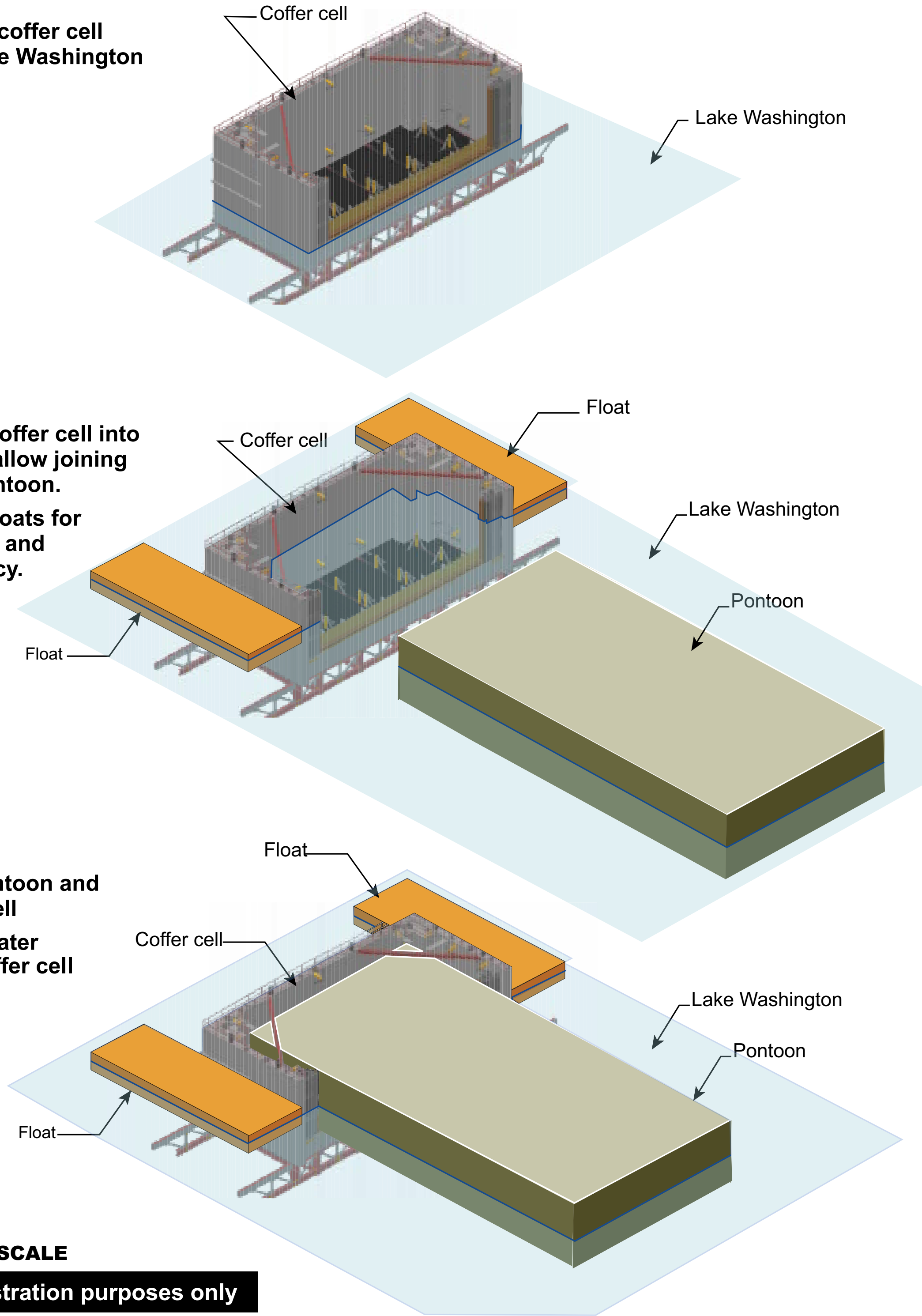
A steel coffer cell -- essentially a large, floating box -- was used to make in-water repairs to two pontoons for the new SR 520 floating bridge.

SR 520 pontoon repairs in a coffer cell on Lake Washington

STEP 1
- Launch coffer cell into Lake Washington

STEP 2
- Lower coffer cell into lake to allow joining with pontoon.
- Install floats for stability and buoyancy.

STEP 3
- Join pontoon and coffer cell
- Pump water from coffer cell



NOT TO SCALE

For illustration purposes only

November 2013

A coffer cell is launched in Lake Washington. The 660-ton coffer cell is 35 feet tall, 45 feet wide, and 144 feet long. It provides a dry work environment where repairs can be made on the final two Cycle 1 pontoons (Pontoons U and V). As shown in the graphic above, the coffer cell is attached to the ends of the pontoons before water is pumped out of it. Once dry, crews are able to complete epoxy injections, crystalline waterproofing, transverse post-tensioning and application of carbon-fiber wrap.

View a video of repair procedures on YouTube at *bit.ly/pontoonvid*

December 2013/January 2014

Repairs to the pontoons on Lake Washington begin. Crews complete crack repairs and repairs to other construction anomalies, such as sections where steel rebar is exposed to water.

June 2014

All pontoon repairs are completed.

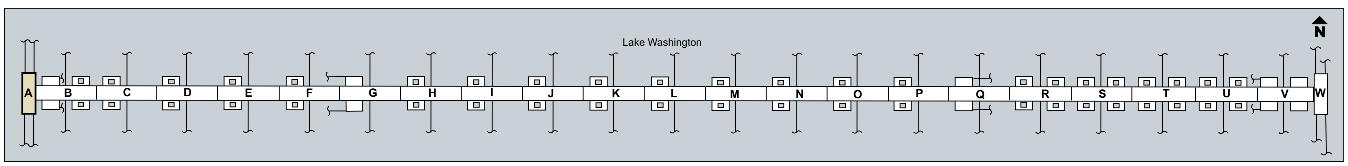
Appendix two: build your own floating bridge pontoons

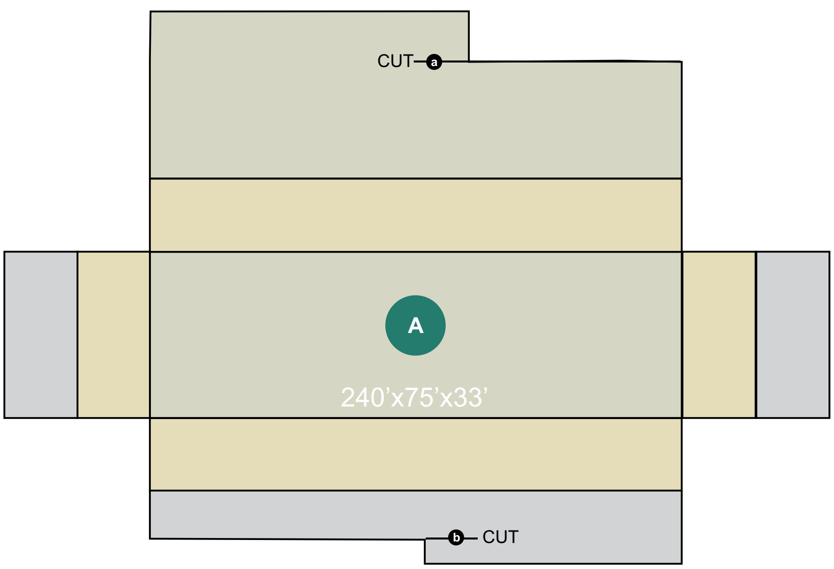
The construction of the floating bridge pontoons was a key milestone for the SR 520 Floating Bridge and Landing Project. Now you can build your own replica of the floating bridge using the printable pontoon templates linked here (pdf 11mb).

The floating bridge has 77 pontoons. Each pontoon is labeled according to its location within the final bridge structure, which is shown in the graphic below. Each template includes the date when that specific pontoon arrived on Lake Washington.

The larger image below is an example of what each pontoon template looks like. Each template uses one letter-size (8.5- by 11-inch) sheet of paper. Be sure to use your printer's single-sided setting when printing the templates. Each pontoon template includes cutting and folding instructions.

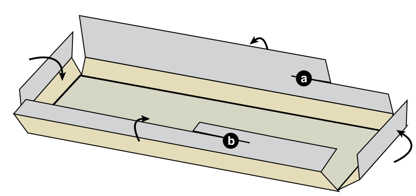
Building your own pontoon





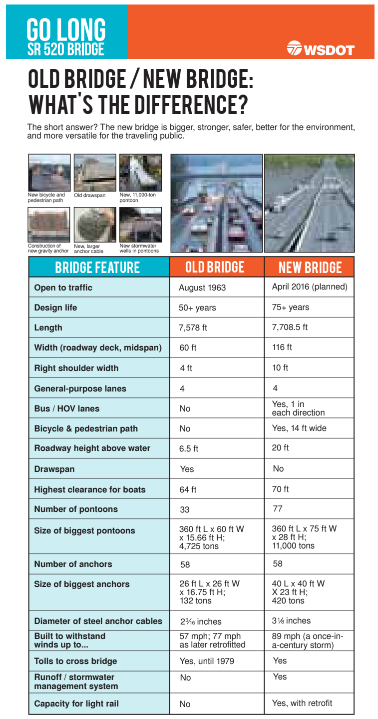
Instruction:

1. Cut around the edge
2. Cut (a) and (b)
3. Fold all flaps in
4. insert (a) into (b)

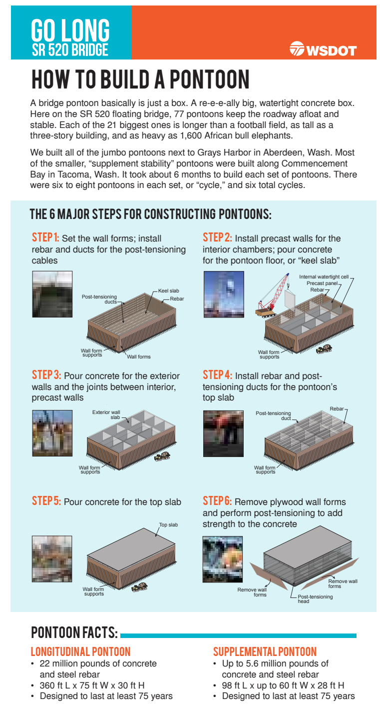


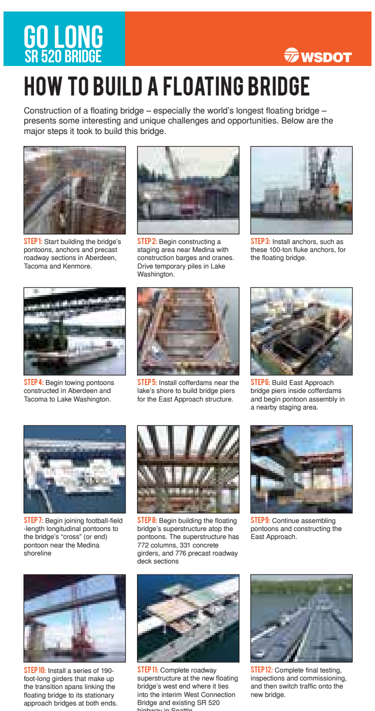
Appendix three: Grand Opening informational display boards

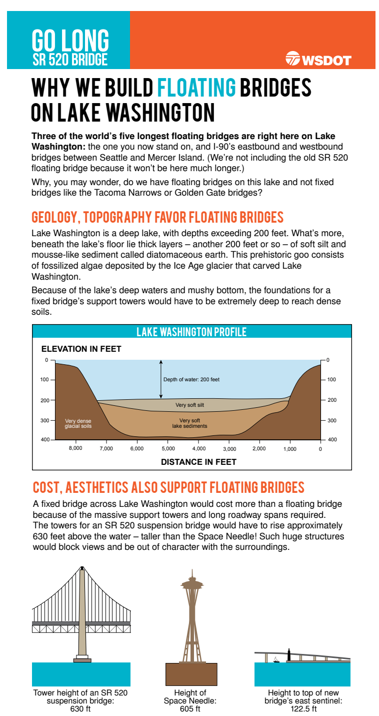
Click on any of the display boards that follow to see a larger image.

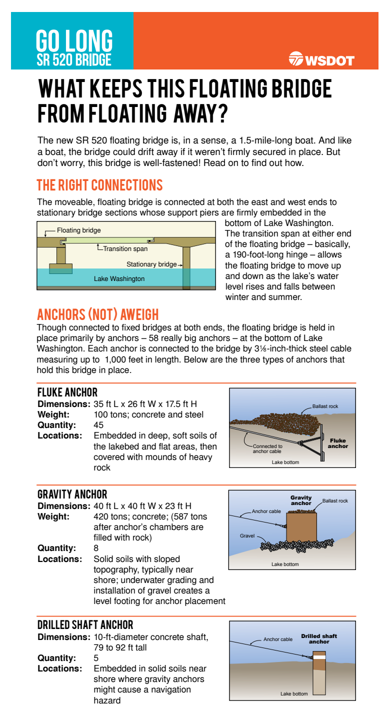


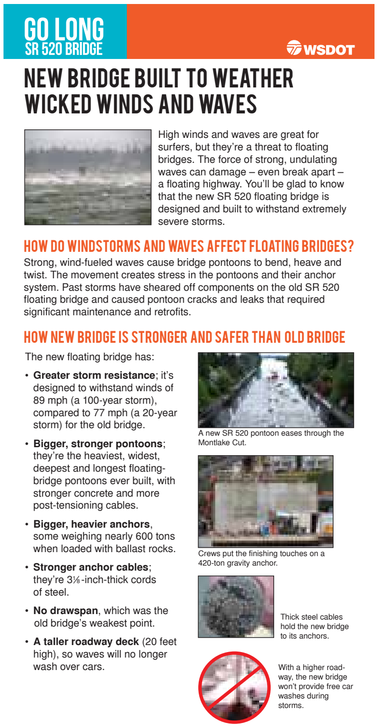
BRIDGE FEATURE	OLD BRIDGE	NEW BRIDGE
Open to traffic	August 1963	April 2016 (planned)
Design life	50+ years	75+ years
Length	7,578 ft	7,708.5 ft
Width (roadway deck, midspan)	60 ft	116 ft
Right shoulder width	4 ft	10 ft
General-purpose lanes	4	4
Bus / HOV lanes	No	Yes, 1 in each direction
Bicycle & pedestrian path	No	Yes, 14 ft wide
Roadway height above water	6.5 ft	20 ft
Drawspan	Yes	No
Highest clearance for boats	64 ft	70 ft
Number of pontoons	33	77
Size of biggest pontoons	360 ft L x 60 ft W x 15.66 ft H; 4,725 tons	360 ft L x 75 ft W x 28 ft H; 11,000 tons
Number of anchors	58	58
Size of biggest anchors	26 ft L x 26 ft W x 16.75 ft H; 132 tons	40 L x 40 ft W X 23 ft H; 420 tons
Diameter of steel anchor cables	2³⁄₁₆ inches	3¼ inches
Built to withstand winds up to...	57 mph; 77 mph as later retrofitted	89 mph (a once-in-a-century storm)
Tolls to cross bridge	Yes, until 1979	Yes
Runoff / stormwater management system	No	Yes
Capacity for light rail	No	Yes, with retrofit











GO LONG
SR 520 BRIDGE
WSDOT

NEW BRIDGE BUILT TO WEATHER WICKED WINDS AND WAVES

High winds and waves are great for surfers, but they're a threat to floating bridges. The force of strong, undulating waves can damage – even break apart – a floating highway. You'll be glad to know that the new SR 520 floating bridge is designed and built to withstand extremely severe storms.

HOW DO WINDSTORMS AND WAVES AFFECT FLOATING BRIDGES?

Strong, wind-fueled waves cause bridge pontoons to bend, heave and twist. The movement creates stress in the pontoons and their anchor system. Past storms have sheared off components on the old SR 520 floating bridge and caused pontoon cracks and leaks that required significant maintenance and retrofits.

HOW NEW BRIDGE IS STRONGER AND SAFER THAN OLD BRIDGE

The new floating bridge has:

- **Greater storm resistance**; it's designed to withstand winds of 89 mph (a 100-year storm), compared to 77 mph (a 20-year storm) for the old bridge.
- **Bigger, stronger pontoons**; they're the heaviest, widest, deepest and longest floating-bridge pontoons ever built, with stronger concrete and more post-tensioning cables.
- **Bigger, heavier anchors**, some weighing nearly 600 tons when loaded with ballast rocks.
- **Stronger anchor cables**; they're 3⅛-inch-thick cords of steel.
- **No drawspan**, which was the old bridge's weakest point.
- **A taller roadway deck** (20 feet high), so waves will no longer wash over cars.

A new SR 520 pontoon eases through the Montlake Cut.

Crews put the finishing touches on a 420-ton gravity anchor.

Thick steel cables hold the new bridge to its anchors.

With a higher roadway, the new bridge won't provide free car washes during storms.

GO LONG
SR 520 BRIDGE
WSDOT

HEY, LET'S KEEP THE NOISE DOWN!

Living next to a busy highway can be noisy. Learn about how WSDOT keeps the noise down for our neighbors and our fishy friends living in the lake.

HERE'S HOW WE MINIMIZE HIGHWAY NOISE FOR OUR NEIGHBORS

- Noise walls on the Eastside
- Highway lids on the east and west sides of Lake Washington
- Quieter, next-generation concrete pavement along the highway and ramps
- Taller-than-standard lane barriers
- Encapsulated bridge expansion joints
- A reduced speed limit (45 mph) on the Portage Bay Bridge

Quieter expansion joints on bridges.

New lid at 92nd Avenue Northeast.

HERE'S HOW WE ADDRESS NOISE DURING CONSTRUCTION

Removing old ramps in Montlake.

Driving piles in Union Bay.

Here are some of the things we do during construction to limit noise:

- Restrict the really noisy work, such as pile driving, to daytime hours
- Use back-up beepers that adjust their volume to the surrounding noise
- Use sound-dampening bed liners in our trucks
- Place noise shields on loud stationary equipment
- Limit engine idling on site

HERE'S HOW WE PROTECT OUR FRIENDS WITH FINS

Significant in-water work is required to build a bridge across Lake Washington. Loud noise reverberating through water can harm or even kill fish. To protect fish, crews use special equipment that reduces the sound waves that travel through water. A bubble curtain (seen at right) produces a wall of bubbles around steel piles as they're driven into the lakebed. The curtain of bubbles reflects, absorbs, and weakens the sound coming from the steel pile.

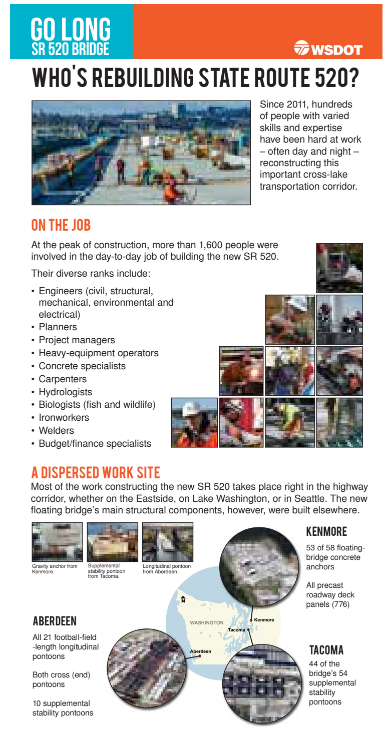
Also, crews do certain in-water work only during approved times of the year when fish are not migrating through the project area.

A bubble curtain in use on Lake Washington.

HOW LOUD IS LOUD?

Noise or sound travels differently depending on the environment. Humans cannot hear all sounds that travel through the air. The loudness of sound is measured in units called decibels (dBA). The more decibels, the louder the sound. Sound has to be at a certain decibel for us to hear it.

The noise thermometer at left shows the relative sound levels of common activities.



GO LONG
SR 520 BRIDGE
WSDOT

WHO'S REBUILDING STATE ROUTE 520?

Since 2011, hundreds of people with varied skills and expertise have been hard at work – often day and night – reconstructing this important cross-lake transportation corridor.

ON THE JOB

At the peak of construction, more than 1,600 people were involved in the day-to-day job of building the new SR 520.

Their diverse ranks include:

- Engineers (civil, structural, mechanical, environmental and electrical)
- Planners
- Project managers
- Heavy-equipment operators
- Concrete specialists
- Carpenters
- Hydrologists
- Biologists (fish and wildlife)
- Ironworkers
- Welders
- Budget/finance specialists

A DISPERSED WORK SITE

Most of the work constructing the new SR 520 takes place right in the highway corridor, whether on the Eastside, on Lake Washington, or in Seattle. The new floating bridge's main structural components, however, were built elsewhere.

Gravity anchor from Kenmore.

Supplemental stability pontoon from Tacoma.

Longitudinal pontoon from Aberdeen.

KENMORE

53 of 58 floating-bridge concrete anchors

All precast roadway deck panels (776)

ABERDEEN

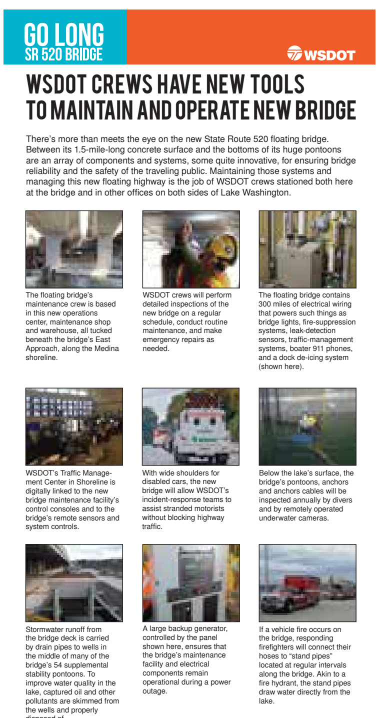
All 21 football-field -length longitudinal pontoons

Both cross (end) pontoons

10 supplemental stability pontoons

TACOMA

44 of the bridge's 54 supplemental stability pontoons



GO LONG
SR 520 BRIDGE
WSDOT

WSDOT CREWS HAVE NEW TOOLS TO MAINTAIN AND OPERATE NEW BRIDGE

There's more than meets the eye on the new State Route 520 floating bridge. Between its 1.5-mile-long concrete surface and the bottoms of its huge pontoons are an array of components and systems, some quite innovative, for ensuring bridge reliability and the safety of the traveling public. Maintaining those systems and managing this new floating highway is the job of WSDOT crews stationed both here at the bridge and in other offices on both sides of Lake Washington.

The floating bridge's maintenance crew is based in this new operations center, maintenance shop and warehouse, all tucked beneath the bridge's East Approach, along the Medina shoreline.

WSDOT crews will perform detailed inspections of the new bridge on a regular schedule, conduct routine maintenance, and make emergency repairs as needed.

The floating bridge contains 300 miles of electrical wiring that powers such things as bridge lights, fire-suppression systems, leak-detection sensors, traffic-management systems, boater 911 phones, and a dock de-icing system (shown here).

WSDOT's Traffic Management Center in Shoreline is digitally linked to the new bridge maintenance facility's control consoles and to the bridge's remote sensors and system controls.

With wide shoulders for disabled cars, the new bridge will allow WSDOT's incident-response teams to assist stranded motorists without blocking highway traffic.

Below the lake's surface, the bridge's pontoons, anchors and anchors cables will be inspected annually by divers and by remotely operated underwater cameras.

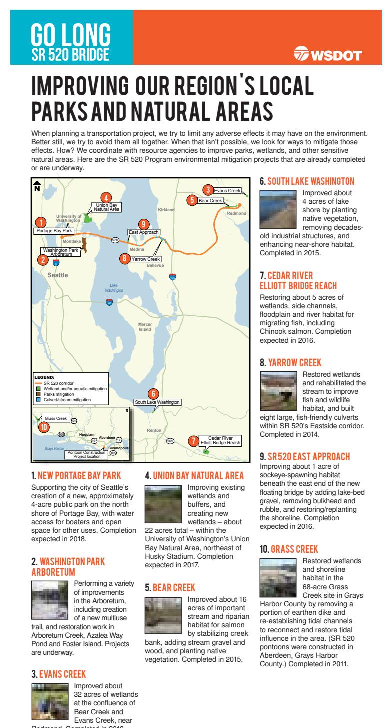
Stormwater runoff from the bridge deck is carried by drain pipes to wells in the middle of many of the bridge's 54 supplemental stability pontoons. To improve water quality in the lake, captured oil and other pollutants are skimmed from the wells and properly disposed of.

A large backup generator, controlled by the panel shown here, ensures that the bridge's maintenance facility and electrical components remain operational during a power outage.

If a vehicle fire occurs on the bridge, responding firefighters will connect their hoses to "stand pipes" located at regular intervals along the bridge. Akin to a fire hydrant, the stand pipes draw water directly from the lake.

GO LONG
SR 520 BRIDGE
WSDOT

SR 520: WHERE SCIENCE, TECHNOLOGY, ENGINEERING AND MATH MEET THE ROAD



GO LONG
SR 520 BRIDGE
WSDOT

IMPROVING OUR REGION'S LOCAL PARKS AND NATURAL AREAS

When planning a transportation project, we try to limit any adverse effects it may have on the environment. Better still, we try to avoid them all together. When that isn't possible, we look for ways to mitigate those effects. How? We coordinate with resource agencies to improve parks, wetlands, and other sensitive natural areas. Here are the SR 520 Program environmental mitigation projects that are already completed or are underway.

1. NEW PORTAGE BAY PARK

Supporting the city of Seattle's creation of a new, approximately 4-acre public park on the north shore of Portage Bay, with water access for boaters and open space for other uses. Completion expected in 2018.

2. WASHINGTON PARK ARBORETUM

Performing a variety of improvements in the Arboretum, including creation of a new multiuse trail, and restoration work in Arboretum Creek, Azalea Way Pond and Foster Island. Projects are underway.

3. EVANS CREEK

Improved about 32 acres of wetlands at the confluence of Bear Creek and Evans Creek, near Redmond. Completed in 2013.

4. UNION BAY NATURAL AREA

Improving existing wetlands and buffers, and creating new wetlands – about 22 acres total – within the University of Washington's Union Bay Natural Area, northeast of Husky Stadium. Completion expected in 2017.

5. BEAR CREEK

Improved about 16 acres of important stream and riparian habitat for salmon by stabilizing creek bank, adding stream gravel and wood, and planting native vegetation. Completed in 2015.

6. SOUTH LAKE WASHINGTON

Improved about 4 acres of lake shore by planting native vegetation, removing decades-old industrial structures, and enhancing near-shore habitat. Completed in 2015.

7. CEDAR RIVER ELLIOTT BRIDGE REACH

Restoring about 5 acres of wetlands, side channels, floodplain and river habitat for migrating fish, including Chinook salmon. Completion expected in 2016.

8. YARROW CREEK

Restored wetlands and rehabilitated the stream to improve fish and wildlife habitat, and built eight large, fish-friendly culverts within SR 520's Eastside corridor. Completed in 2014.

9. SR 520 EAST APPROACH

Improving about 1 acre of sockeye-spawning habitat beneath the east end of the new floating bridge by adding lake-bed gravel, removing bulkhead and rubble, and restoring/replanting the shoreline. Completion expected in 2016.

10. GRASS CREEK

Restored wetlands and shoreline habitat in the 68-acre Grass Creek site in Grays Harbor County by removing a portion of earthen dike and re-establishing tidal channels to reconnect and restore tidal influence in the area. (SR 520 pontoons were constructed in Aberdeen, Grays Harbor County.) Completed in 2011.